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Summary of Group II Control Technique Guideline Documents for Control of Volatile Organic Emissions from Existing Stationary Sources

GCA Corp.
Bedford, MA

Prepared for

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Control Technique Guideline (CTG) documents have been prepared by the Office of Air Quality Planning and Standards of the U.S. EPA to assist states in defining reasonably available control technology (RACT) for the control of volatile organic compound emissions from existing stationary sources. A document (EPA-450/3-78-120) summarizing the CTG documents issued prior to January 1978 (Group I) was published in December 1978.

This document (EPA-450/2-80-001) summarizes the CTG documents issued between January 1978 and January 1979 (Group II). A description of each source category is provided, along with RACT and costs to retrofit a model facility. The source categories included are: leaks from petroleum refinery equipment, surface coating of miscellaneous metal parts and products, manufacture of vegetable oil, surface coating of flat wood paneling, synthesized pharmaceutical products manufacturing, pneumatic rubber tire manufacturing, graphic arts (rotogravure and flexography), external floating roof tanks, perchloroethylene dry cleaning, and leaks from gasoline tank trucks and vapor collection systems.

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This document (EPA-450/2-80-001) summarizes the CTG documents issued between January 1978 and January 1979 (Group II). A description of each source category is provided, along with RACT and costs to retrofit a model facility.

CONTENTS

Abstract iii

1. Introduction. 1
   Background 1
   Purpose of Document. 3
2. Surface Coating of Miscellaneous Metal Parts and Products 5
3. Surface Coating of Flat Wood Paneling 7
4. Manufacture of Synthesized Pharmaceutical Products. 9
5. Manufacture of Pneumatic Rubber Tires 12
6. Manufacture of Vegetable Oil. 14
7. Graphic Arts — Rotogravure and Flexography. 16
8. Perchloroethylene Dry Cleaning Systems. 18
9. Leaks from Petroleum Refinery Equipment 20
10. Petroleum Liquid Storage in External Floating Roof Tanks. 23
11. Leaks from Gasoline Tank Trucks and Vapor Collection Systems. . . 26

References 28

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SECTION 1

INTRODUCTION

BACKGROUND

The Clean Air Act Amendments of 1977 require each state in which there is a nonattainment area to adopt and submit a revised State Implementation Plan (SIP) that meets the requirements of Section 110 and Subpart D of the Act. The oxidant plan portion of the SIP submittals must contain regulations which reflect the application of reasonably available control technology (RACT) to stationary sources for which control techniques guidelines (CTG) documents have been published.*

Eleven CTGs covering 15 VOC source categories were published prior to January 1978. These first eleven CTGs were:

- Surface Coating of Cans, Coils, Paper, Fabric, Automobiles and Light-Duty Trucks (EPA-450/2-77-008).
- Surface Coating of Metal Furniture (EPA-450/2-77-032).
- Surface Coating for Insulation of Magnetic Wire (EPA-450/2-77-033).
- Surface Coating of Large Appliances (EPA-450/2-77-034).
- Storage of Petroleum Liquids in Fixed Roof Tanks (EPA-450/2-77-036).
- Bulk Gasoline Plants (EPA-450/2-77-035).
- Solvent Metal Cleaning (EPA-450/2-77-022).
- Use of Cutback Asphalt (EPA-450/2-77-037).
- Refinery Vacuum Producing Systems, Wastewater Separators and Process Unit Turnarounds (EPA-450/2-77-025).

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*RACT regulations would not have to be adopted for these stationary sources, if a state can demonstrate attainment of the photochemical oxidant standard by photochemical dispersion modeling.

- Hydrocarbons from Tank Truck Gasoline Loading Terminals (EPA-450/2-77-026).

- Design Criteria for Stage I Vapor Control Systems, Gasoline Service Stations, U.S. EPA, OAQPS, November 1975.

For each source category, a CTG document describes the source, identifies the VOC emission points, discusses the applicable control methods, analyzes the costs required to implement the control methods, and recommends regulations for limiting VOC emissions from the source.

A document entitled "Regulatory Guidance for Control of Volatile Organic Compound Emissions from 15 Categories of Stationary Sources," EPA-905/2-78-001, was published in April 1978. This document provided guidance to the states in preparing RACT regulations for the 15 source categories listed above.

In December 1978, a document entitled "Summary of Group I Control Technique Guideline Documents for Control of Volatile Organic Emissions from Existing Stationary Sources," EPA-450/3-78-120, was published. This document provided an overview of the affected source facilities, the magnitude of the VOC emissions emitted from the facilities, and the recommended VOC emission limits.

EPA published an additional 10 CTG documents (Group II) in 1978. The 10 source categories covered were:

- Leaks from Petroleum Refinery Equipment (EPA-450/2-78-036).

- Surface Coating of Miscellaneous Metal Parts and Products (EPA-450/2-78-015).

- Manufacture of Vegetable Oil (EPA-450/2-78-035).

- Surface Coating of Flat Wood Paneling (EPA-450/2-78-032).

- Manufacture of Synthesized Pharmaceutical Products (EPA-450/2-78-029).

- Manufacture of Pneumatic Rubber Tires (EPA-450/2-78-030).

- Graphic Arts - Rotogravure and Flexography (EPA-450/2-78-033).

- Petroleum Liquid Storage in External Floating Roof Tanks (EPA-450/2-78-047).

- Perchloroethylene Dry Cleaning Systems (EPA-450/2-78-050).

- Leaks from Gasoline Tank Trucks and Vapor Collection Systems (EPA-450/2-78-051).

A regulatory guidance document was developed from these Group II CTGs. Published in September 1979 and entitled "Guidance to State and Local Agencies in Preparing Regulations to Control Volatile Organic Compounds from Ten Stationary Source Categories," EPA-450/2-79-004, this document provided assistance to state and local agencies in preparing RACT regulations for the 10 industrial categories covered by the Group II CTG documents.

PURPOSE OF DOCUMENT

The purpose of this report is to summarize the Group II CTG documents. The summaries are intended to present an overview of the affected source facilities, the magnitude of the VOC emissions emitted from the facilities, and the recommended VOC emission limits. More complete information about the recommended control techniques for an individual source category can be obtained by referring to the specific CTG document cited at the beginning of each section. The regulatory guidance document cited above (EPA-450/2-79-004) provides a discussion of areas where difficulties exist in converting CTG information into regulatory language, a compilation of industry comments on CTG information after it had been converted into a regulatory format, and identification of specific areas of industry concern. For this executive summary, information not available in the 10 CTG documents was supplemented with inputs from other sources.

Cost estimates in the CTG documents were normally developed by use of model facilities to represent typical operations. Applicable alternative controls were costed for these model facilities. As such, these costs, even with the broad ranges provided for several of the source categories, may not encompass the actual cost incurred at any specific facility.

The CTG document summaries which follow include a brief discussion of the VOC source category and emission control techniques, as well as a tabular presentation of the following information for each source category:

Affected Facilities — Types of operations, facilities, or equipment covered by the CTG

Number of Affected Facilities — A national count of the operations, facilities, or equipment specified

VOC Emissions Nationwide — Estimate of annual emissions from the source category

VOC Emission Range per Facility — Estimate of annual emissions from a typical facility in the source category

100 Ton/Yr Source Size — The estimated size of a facility which would emit 100 ton/yr of VOC if uncontrolled

CTG Emission Limit - VOC emission limits as recommended in the CTG document

VOC Reduction Per Facility — Percent emission reduction which can be effected by use of CTG recommended controls

Costs — Values in parentheses represent net savings

Capital — purchase and installation costs

Annualized — includes operating cost, annualized capital charges plus tax and interest, less value of recovered VOC. Only primary heat recovery or fuel value credit considered

Cost Effectiveness — Cost of control measure per ton of VOC controlled.

SECTION 2

SURFACE COATING OF MISCELLANEOUS METAL PARTS AND PRODUCTS[1]

This CTG document provides guidance on VOC emission control for job shop and original equipment manufacturing industries which apply coatings on metal substrates, except those industries which were covered by previous CTG documents. The recommended emission limits in this CTG are also intended to apply to the coating of hardware for wood and metal cabinets and the coating of metal pails and drums. There are many dissimilarities between the plants and industries represented by this category.

Spraying is the more common method of applying coatings for single-coat operations, but flow coating and dipping are also used. For two-coat operations the primers are more likely to be applied either by flow or dip coating while the topcoats are almost always sprayed.

The coated parts are often conveyed through a flashoff tunnel to evaporate solvent and allow the coating to flow out properly. After coating and flashoff, the parts are baked in single or multiple pass baking ovens. Some products are air or forced air dried.

The recommended emission limits are based on the use of coatings low in organic solvents. The CTG document recommends four different emission limitations based on the type of coating, the number of colors or color changes and the method of drying. The applicable control technology to meet the emission limitations includes process modifications (such as conversion to waterborne, electrodeposition, higher solids or powder coatings) and exhaust gas treatment (such as incineration and carbon adsorption).

Due to the large number of different coating processes and the various methods of controlling VOC emissions from each of these processes, there are significant variations in the cost-effectiveness of control options for this CTG category. The CTG document provides cost estimates for small, medium and large model plants for seven different types of coating operations and between four and six control options depending on the type of coating operation.

SUMMARY OF CTG DOCUMENT FOR SURFACE COATING OF MISCELLANEOUS METAL PARTS AND PRODUCTS

Affected facilities (p. 1-2)*	Coating application areas, flashoff areas, dryers, and ovens for manufacturers of: a. Large farm machinery b. Small farm machinery c. Small appliances d. Commercial machinery e. Industrial machinery f. Fabricated metal products g. Any other industrial category, which coats metals, under SIC major groups 33-39, inclusive. Except those facilities which are covered by previous CTGs.
Number of affected facilities	96,000[14]
VOC emissions nationwide	9.0×10^5 Mg/yr (1×10^6 tons/yr) estimated for 1977, which represents about 5.0 percent of stationary source estimated emissions.[14]
VOC emission range per facility (pp. 1-10, 2-3)*	a. An emission factor of 0.66 kg VOC/l coating less water (5.5 lb VOC/gal coating less water) can be expected from a facility utilizing a coating composed of 75 percent organic solvent, 25 percent solids by volume. b. For facilities utilizing an electrodeposition process the VOC emission factor is 0.36 kg VOC/l coating less water (3.0 lb/gal).
100 tons/yr source size (calculated)	An emission factor of 5.5 lb VOC/gal implies that a minimum process rate of 3.64×10^5 gal coating material/yr would be required for a facility to be a potential 100 tons/yr source.
CTG emission limit (p. v)*	Coating method — Recommended limitation (wt. VOC / vol. coating) a. Air or forced air dried items — 0.42 kg/l (3.5 lb/gal) b. Clear coat — 0.52 kg/l (4.3 lb/gal) c. No or infrequent color change or small number of colors applied 1. Powder coatings — 0.05 kg/l (0.4 lb/gal) 2. Other — 0.36 kg/l (3.0 lb/gal) d. Outdoor, harsh exposure or extreme performance characteristics — 0.42 kg/l (3.5 lb/gal) e. Frequent color change, large number of colors applied, or first coat on untreated ferrous substrate — 0.36 kg/l (3.0 lb/gal)
VOC reduction per facility (p. 2-1)*	Percent reduction in VOC emissions Process modification (coating/equipment change) 50-98 Exhaust gas treatment 90+
Costs (pp. 3-8 to 3-14)*	Basis: A medium size coating line (~ 743,000 m^2/yr, ~ 8×10^6 ft^2/yr) with single or two coat operation using flow-coat, dip-coat, or spray-coat applications. The ranges cover the costs of several different VOC control options. Capital cost ($1000) 20-1,837 Annualized cost ($1000) (27)†-602 Cost effectiveness ($/Mg) (290)†-6,841 ($/ton) (263)†-6,206

*The source of the summary information is the indicated page number in "Control of Volatile Organic Emissions from Existing Stationary Sources, Volume VI: Surface Coating of Miscellaneous Metal Parts and Products," EPA-450/2-78-015.

†Numbers in parentheses are savings.

SECTION 3

SURFACE COATING OF FLAT WOOD PANELING[2]

Factory finished flat wood products includes printed interior panels made of hardwood plywood and thin particle board (1/4 inch or less); natural finish hardwood plywood panels; and hardboard paneling with Class II finishes. ANSI Class II finishes meet less stringent requirements than Class I coatings; specifically there are no heat, humidity or steam requirements.

Different forms of roll coating are the favored procedures for applying coatings to flat woods. However, curtain coating, spray coating, and brush coating techniques are also used. The basic series of coatings applied to printed interior panels consist of filler, basecoat, inks and topcoat. Natural hardwood plywood panels usually have the real wood surface modified in color and appearance by a series of stains, toners, fillers, scalers, glazes, and topcoats.

For purposes of recommending levels of control, flat wood interior panel products have been divided into three subcategories:

1. Printed interior wall panels made of hardwood plywood and thin particle board (1/4 inch or less);

2. Natural finish hardwood plywood; and

3. Class II finishes for hardwood paneling.

Class I hardwood panels, particle board used in furniture, insulation board, and softwood plywood are not considered in this CTG document. The emissions from inks used to print simulated grain or decorative patterns on printed interior panels are covered in this CTG category, and should not be considered a Graphic Arts activity.

Recommended VOC limitations are given in kg/100 m^2 (lb/1000 ft^2) of surface covered to allow panel coaters maximum flexibility in adjusting VOC content of the different coatings so as to meet the emission limitation while maintaining product quality. In each case, the aggregate of the VOC emissions from all coating applied shall be used for comparison to the recommended emission limitations. In general, the emission limitations are based on the use of a combination of water-borne coatings and solvent-borne coatings within a product line. Other applicable methods of VOC reduction include add-on devices (incinerators and carbon adsorbers), ultraviolet curing, and electron beam curing.

SUMMARY OF CTG DOCUMENT FOR FACTORY SURFACE COATING OF FLAT WOOD PANELING

Affected facilities (p. 1-2)*	The affected facilities are factories that surface coat the following types of flat wood panels: a. Hardwood plywood b. Particleboard c. Hardboard
Number of affected facilities (p. 1-2)*	Affected Facilities — Nationwide Total a. Hardwood plywood — 247 b. Particleboard — 80 c. Hardboard — 67
VOC emissions nationwide	8.4×10^4 Mg/yr (9.3×10^4 tons/yr) estimated for 1977 which represents about 0.5 percent of stationary source estimated emissions.[11]
VOC emission range per facility (Table 2-2 p. 2-5)*	Potential VOC emissions per coated surface area are: 0.4 to 8.0 kg/100 m^2 (0.8 to 16.5 lb/1000 ft^2) depending on the coating/curing process as well as the coating materials used.
100 tons/yr source size (calculated)	Based on the VOC emission range above, a 100 tpy source would coat a minimum annual throughput of: 3.8×10^5 to 7.7×10^6 standard panels/yr Where a standard panel is 2.97 m^2 (32 ft^2).
CTG emission limit (p. v)*	Recommended limitation Printed hardwood plywood and particleboard — 2.9 kg VOC/100 m^2 (6.0 lb VOC/1000 ft^2) Natural finish hardwood plywood — 5.8 kg VOC/100 m^2) (12.0 lb VOC/1000 ft^2) Class II† finishes for hardboard paneling — 4.8 kg VOC/100 m^2) (10.0 lb VOC/1000 ft^2)
VOC reduction per facility (Table 2-1 p. 2-4)*	70 to 90 percent VOC emission reduction, depending on coating material and coverage, through use of water-borne coatings, incineration, adsorption, ultraviolet curing or electron beam curing.

Costs (Table 3-2 p. 3-9)*

Basis:	Shifts: 1		Shifts: 2	
	Panels/yr: 2,000,000		Panels/yr: 4,000,000	
	Waterborne	UV/Waterborne	Waterborne	UV/Waterborne
Capital cost ($1000)	52	155	52	155
Annualized cost ($1000)	101	124.6	200.8	234.4
Cost effectiveness ($/Mg)	269	292	256	264
Cost effectiveness ($/ton)	244	264	232	240

*The source of the summary information is the indicated page number in "Control of Volatile Organic Emissions from Existing Stationary Sources, Volume VII: Factory Surface Coating of Flat Wood Paneling," EPA-450/2-78-032.

†Definition on p. vii of EPA-450/2-78-032.

SECTION 4

MANUFACTURE OF SYNTHESIZED PHARMACEUTICAL PRODUCTS[3]

The CTG covers the manufacture of synthesized pharmaceutical products under SIC codes 2833 and 2834. Synthesized pharmaceutical products are normally manufactured in a series of batch operations according to the following sequence: (a) reaction(s), (b) product separation, (c) purification, and (d) drying. The equipment which emit VOC during this process are: reactors, distillation units, dryers, crystallizers, filters, centrifuges, extractors and VOC storage tanks. VOC emission rates from each of these sources vary tremendously, so that typical emission rates by either process component or facility type are not calculated in the CTG document.

The recommended control strategy for reactors, distillation operations, crystallizers, centrifuges and vacuum dryers that emit 6.8 kg/day (15 lb/day) or more of VOC is installation of a surface condenser on the equipment exhaust. Operation of the surface condenser must be such that the exhaust gas temperature is reduced to:

(1) -25°C when condensing VOC of vapor pressure greater than 40 kPa (5.8 psi),*

(2) -15°C when condensing VOC of vapor pressure greater than 20 kPa (2.9 psi),*

(3) 0°C when condensing VOC of vapor pressure greater than 10 kPa (1.5 psi),*

(4) 10°C when condensing VOC of vapor pressure greater than 7 kPa (1.0 psi),* and

(5) 25°C when condensing VOC of vapor pressure greater than 3.5 kPa (0.5 psi),*

Additional controls are recommended for air dryers, production equipment exhaust systems and storage and transfer of liquids containing VOC. VOC emissions from air dryers and production equipment exhaust systems should be reduced by 90 percent if they emit 150 kg/day (330 lb/day) or more and should be reduced to 15 kg/day (33 lb/day) if they emit less than 150 kg/day (330 lb/day). Transfer of liquids containing VOC from trucks or railcars to tanks with a

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*Vapor pressures as measured at 20°C.

capacity of more than 7,500 liters (2000 gal) should employ a 90 percent effective vapor balance system or equivalent. Tanks storing liquid containing VOC with a vapor pressure greater than 10 kPa (1.5 psi) at 20°C, should have pressure/vacuum vents set at ±0.2 kPa (±0.03 psi) except where more effective controls are used.

There are three remaining recommendations to reduce VOC emissions from pharmaceutical synthesis operations. First, all centrifuges, rotary vacuum filters and other filters with exposed liquid surfaces should be enclosed when processing liquids with a total VOC vapor pressure of 3.5 kPa (0.5 psi) or more at 20°C. Second, all in-process tanks containing liquids with VOC should be covered. Third, all leaks of VOC containing liquids should be repaired as soon as possible.

SUMMARY OF CTG DOCUMENT FOR MANUFACTURE OF SYNTHESIZED PHARMACEUTICAL PRODUCTS

Affected facilities (p. 1-4)*	Synthesized pharmaceutical manufacturing facilities. Specific sources include: 1. Dryers 2. Reactors 3. Distillation Units 4. Storage and transfer of VOC 5. Filters 6. Extraction equipment 7. Centrifuges 8. Crystallizers.
Number of affected facilities (p. 1-2)*	Estimated 800 plants nationwide
VOC emissions nationwide	50,000 Mg/yr (55,000 tons/yr) estimated for 1977 which represents about 0.3 percent of stationary source estimated VOC emissions.[11]
VOC emission range per facility	Not available
100 ton/yr source size	Not available
CTG emission limit (p. 1-5)*	1. a. Surface condensers or equivalent control on vents from reactors, distillation operations, crystallizers, centrifuges, and vacuum dryers that emit 6.8 kg/day (15 lb/day) or more VOC. b. Surface condensers must meet certain temperature versus VOC vapor pressure criteria. 2. Additional specific emission reductions are required for air dryers, production equipment exhaust systems, and storage and transfer of VOC. 3. Enclosures or covers are recommended for rotary vacuum filters, processing liquid containing VOC and in-process tanks. 4. Repair of components leaking liquids containing VOC.
VOC reduction per facility	Not available
Costs (pp. 5-14 to 5-42)*	Capital and Annualized Cost graphs are provided for the following types of control equipment: conservation vents, floating roofs, pressure vessels, carbon adsorption systems, thermal and catalytic incineration systems, water cooled condensers, chilled water and brine cooled condensers, freon cooled condensers, packed bed scrubbers and venturi scrubbers. Cost effectiveness data is not calculated for typical plants.

*The source of the summary information is the indicated page(s) in "Control of Volatile Organic Emissions from Manufacture of Synthesized Pharmaceutical Products," EPA-450/2-78-029.

SECTION 5

MANUFACTURE OF PNEUMATIC RUBBER TIRES[4]

The manufacture of pneumatic rubber tires includes the production of passenger vehicle and light- and medium-duty truck tires, and tires manufactured on assembly lines using automated equipment.

The general process for tire manufacturing consists of: (1) preparation or compounding of raw materials, (2) transformation of these compound materials into tire components, (3) tire assembly, and (4) molding of the final product. Each step employs unit operations that are sources of VOC emissions.

Recommended levels of control are applicable to four of the unit operations which are major sources of VOC emissions at a tire manufacturing plant. The operations are undertread cementing, tread end cementing, bead dipping, and green tire spraying which account for 83 percent of potential VOC emissions from a typical tire manufacturing plant. Compounding, milling, tread and sidewall preparation, calendering, molding and curing, and finishing are not recommended for control because of their lower emission factors. Latex dipping is not frequently employed and will be covered under a textile manufacturing CTG. Tire building, although a significant source, is not recommended for control because the machines occupy about 25 percent of a plant's floor space over which the VOCs are emitted at very dilute concentrations. A plant which manufactures a part of a pneumatic rubber tire by employing one or more of the four affected unit operations is also recommended for control. The manufacture of tire treads for the tire recapping industry should be controlled while the actual recapping operation is not recommended for control.

Quantitative emission limitations are not recommended. However, VOC emissions from the four affected unit operations can be effectively reduced by application of carbon adsorption or incineration systems if capture hoods and ductwork are designed in accordance with good engineering practice. The recommended scheme for reducing VOC emissions from green tire spraying is conversion to water-based sprays. The expected reduction in VOC emissions is shown in the following table.

SUMMARY OF CTG DOCUMENT FOR MANUFACTURE OF PNEUMATIC RUBBER TIRES

Affected facilities (pp. 1-1, 1-3)*	Rubber tire manufacturing plants, producing passenger car, and light and medium duty truck tires. Operations affected are: undertread cementing, bead dipping, tread end cementing, and green tire spraying.
Number of affected facilities (p. 2-2)*	Maximum of 62 rubber tire plants nationwide
VOC emissions nationwide (p. 1-2)*	1976 VOC emissions estimate from rubber tire manufacturing totalled 88,200 Mg/yr (97,200 tons/yr). This quantity represents 0.6 percent of total national VOC emissions from stationary sources.
VOC emission range per facility (p. 1-2)*	The average tire plant is estimated to release 4,000 kg per day (8,820 lb/day) of emissions or 1,000 Mg VOC per year (1,100 tons/yr).
100 tons/yr source size (p. 2-8)*	The model plant, producing 16,000 tires/day, has potential to emit 1,460 Mg/yr (1,600 tons VOC/yr). Therefore a plant producing approximately 1,000 tires/day would be a potential 100 tons/yr source.
CTG emission limit (p. 4-2)*	VOC emissions reduction from the affected operations is recommended through use of carbon adsorption or incineration. Water-based coatings may be used for green tire spraying.
VOC reduction per facility (p. 1-4)*	a. Carbon adsorption gives an overall efficiency of 62-86 percent in reducing VOC emissions, when applied to the affected operations. b. Incineration gives an overall efficiency of 59-81 percent when applied to the affected operations. c. Water-based coatings, applied to green tire spraying, provide an overall emission reduction efficiency of 97 percent.
Costs (pp. 4-11, 4-15)*	Basis: A model 16,000 tires/day plant using the various control technologies recommended on the following affected operations. All costs are based on January 1978 dollars.

	Undertread cementing	Bead dipping	Tread end cementing	Green tire spraying
Capital cost ($1000)	130-340	115-250	135-375	15-450
Annualized cost ($1000)	92-280	70-985	100-340	118-490
Cost effectiveness ($/Mg)	166-505	1,480-20,800	1,140-3,880	202-839
($/ton)	150-458	1,340-18,800	1,000-3,500	184-763

*The source of the summary information is the indicated page(s) in "Control of Volatile Organic Emissions from Manufacture of Pneumatic Rubber Tires," EPA-450/2-78-030.

SECTION 6

MANUFACTURE OF VEGETABLE OIL[5]

This guideline provides information on the vegetable oil process as well as guidance on the planning and analysis required for the control of VOC emissions at vegetable oil extraction facilities. At the time this document was published, EPA acknowledged that there were uncertainties about the testing methods. EPA also had a field testing program that was developing useful data in the area of testing and monitoring. Initial results from several scheduled field tests indicated that the measured data are significantly more variable than had been anticipated. Consequently, in a letter dated June 22, 1979 (see next page), EPA asked the States to defer any regulatory action for vegetable oil plants until after the field testing program is completed and all the data analyzed. It is anticipated that the testing program will be completed in mid-1980. Since the original CTG document may be modified, it is not summarized in this report.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
Office of Air Quality Planning and Standards
Research Triangle Park, North Carolina 27711

DATE JUN 22 1979

SUBJECT: Initial Results of Emission Testing of Volatile Organic Compounds from Vegetable Oils Manufacturing Operations

FROM: Walter C. Barber, Director
Office of Air Quality Planning and Standards (MD-10)

TO: Director, Air and Hazardous Materials Division, Regions I-X

As you are aware, in June 1978 EPA published a Control Techniques Guideline (CTG) for the manufacture of vegetable oils ("Control of Volatile Organic Emissions from Manufacture of Vegetable Oils," EPA-450/2-78-035, June 1978). That document stated that the regulatory guidelines were based on engineering calculations and that further verification of these emission levels would be made upon review of data developed in conjunction with New Source Performance Standard development.

Initial results from the first of several scheduled field tests indicate that the measured results are significantly more variable than originally anticipated. Accordingly, I have concluded that it would be prudent to defer regulatory action for vegetable oil plants until after the test program is completed this fall and all the data have been analyzed.

States should not be required to adopt rules for this CTG category during 1979. Further information will be provided on this matter after the completion of the field test program.

cc: Don Goodwin
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EPA Form 1320-6 (Rev. 3-76)

SECTION 7

GRAPHIC ARTS -- ROTOGRAVURE AND FLEXOGRAPHY[6]

The graphic arts industry encompasses printing operations which fall into four principal categories: letterpress, offset lithography, rotogravure and flexography. This guideline is applicable to the flexographic and rotogravure processes as applied to both publication and packaging printing. Letterpress and offset lithography printing are not affected since these processes use inks containing small quantities of volatile organic compounds.

In flexographic printing, the image areas are raised above the nonimage surface. The distinguishing feature is that the image carrier is made of rubber and other elastomeric materials. In the gravure method of printing, image areas are recessed relative to nonimage area. The image carrier is a copper-plated steel cylinder usually also chrome plated to enhance wear resistance.

The emission limits are based on the use of VOC capture and control equipment, water-borne inks or high solids inks. Emission limits vary for operations using capture and control equipment, primarily because the expected capture efficiencies vary with the type of printing operation.

If water-borne inks are used as a control technique, the volatile fraction of the ink must contain 25 percent or less by volume organic solvent and 75 percent or more water. High solids inks must contain 60 percent or more by volume nonvolatile material.

A potential issue in this CTG category is whether a particular operation is a coating or printing operation. A coating operation is the application of a uniform layer of material across the entire width of a web. A printing operation is the formation of words, designs and pictures, usually by a series of application rolls each with only partial coverage. All units in a machine which contains both coating and printing units will be considered as performing a printing operation. However, the printing of simulated grain or decorative patterns on printed interior panels is not covered in this CTG category, and should be considered as a Flat Wood Paneling coating activity.

SUMMARY OF CTG DOCUMENT FOR GRAPHIC ARTS — ROTOGRAVURE AND FLEXOGRAPHY

Affected facilities (p. 1-1)*	Flexographic and rotogravure processes applied to publication and packaging printing.				
Number of affected facilities (p. 2-5)*	a. Publication printing is done in large printing plants, numbering less than 50 in total. b. There are approximately 13 to 14 thousand gravure printing units and 30 thousand flexographic printing units.				
VOC emissions nationwide (p. 2-8)*	a. Gravure 100,000 Mg/yr 1976 (110,000 tons/yr) b. Flexography 30,000 Mg/yr 1976 (33,000 tons/yr) This represents about 0.8 percent of stationary source estimated emissions.[11]				
VOC emission range per facility (calculated)	a. Gravure 7.4 Mg/printing unit per year (8.2 tons/unit) b. Flexography 1 Mg/printing unit per year (1.1 tons/printing unit per year)				
100 tons/yr source size	A plant will be a potential 100 tons/yr VOC source if it uses 110-180 Mg (120-200 tons) of ink per year, where the solvent concentration is 50-85 percent.				
CTG emission limit (pp. 1-2, 1-3)*	Use of water-borne or high solids inks meeting certain composition criteria or the use of capture and control equipment which provides: a. 75 percent overall VOC reduction where a publication rotogravure process is employed; b. 65 percent overall VOC reduction where a packaging roto-rotogravure process is employed; or, c. 60 percent overall VOC reduction where a flexographic printing process is employed.				
VOC reduction per facility	Same as CTG limit above.				
Costs (pp. 4-8 4-13)*	VOC control option	Incinerator	Incinerator	Carbon adsorption	Carbon adsorption
	Ink usage, Mg/yr (tons/yr)	7 (7.7)	2,500 (2,750)	3,500 (3,860)	7,000 (7,720)
	VOC concentration ppm	500	500	1,200	2,400
	Capital cost	94,000	1,110,000	701,000	701,000
	Annualized cost	24,900	1,665,500	72,800	(41,700)†
	Cost effectiveness $/Mg	8,360	1,650	51	(15)†
	$/ton	7,570	1,480	46	(13)†

*The source of the summary information is the indicated page number in "Control of Volatile Organic Emissions from Existing Stationary Sources, Volume VIII: Graphic Arts — Rotogravure and Flexography," EPA-450/2-78-033.

†Numbers in parentheses are savings.

SECTION 8

PERCHLOROETHYLENE DRY CLEANING SYSTEMS[7]

The dry cleaning industry is segregated into three categories: (1) coin-operated, (2) commercial, and (3) industrial. The principal steps in the dry cleaning process are identical to those of ordinary laundering in water: (1) one or more washes (baths) in solvent; (2) extraction of excess solvent by spinning; and (3) drying by tumbling in an air stream.

The CTG recommended emission limitation is based on use of a carbon adsorption system, good maintenance practices and reduction of VOC emissions from filtration and distillation wastes. The carbon adsorption system should reduce VOC emissions to 100 ppm or less before dilution. Good maintenance practices include repairing all gaseous and liquid leaks. Diatomaceous earth filters should be reduced to no more than 25 kg of solvent per 100 kg of wet waste materials. Residue from solvent stills should contain no more than 60 kg of solvent per 100 kg of wet waste material. Filtration cartridges should be drained in the filter housing for at least 24 hours before being discarded.

The CTG document indicates that most, if not all, coin-operated facilities will have insufficient space or steam capacity to install a carbon adsorption system. These facilities should be exempted from having to install adsorption equipment, but should be required to meet the other housekeeping type of requirements.

SUMMARY OF CTG DOCUMENT FOR PERCHLOROETHYLENE DRY CLEANING SYSTEMS

Affected facilities (p. 2-1)*	Affected facilities are coin-operated, commercial, and industrial dry cleaning systems which utilize perchloroethylene as solvent.
Number of affected facilities (calculated)	a. Coin-op 14,900 b. Commercial 44,600 c. Industrial 230
VOC emissions nationwide (pp. 1-2, 2-1)*	a. Coin-op 21,400 Mg/yr (23,500 tons/yr) b. Commercial 123,000 Mg/yr (135,000 tons/yr) c. Industrial 13,600 Mg/yr (15,000 tons/yr) The estimated 158,000 Mg VOC/yr is 0.9 percent of total stationary source estimated emissions.
VOC emission range per facility (p. 5-2)*	Uncontrolled VOC emissions Type of plant — kg/yr — (lb/yr) a. Coin-op 1,460 (3,200) b. Commercial 3,240 (7,200) c. Industrial 32,400 (72,000)
100 tons/yr source size (extrapolated)	A large industrial dry cleaning plant, processing 750 Mg (825 tons) of clothes per year, would be a potential 100 tons VOC per year source.
CTG emission limit (pp. 6-1 – 6-4)*	a. Reduction of dryer outlet concentration to less than 100 ppm VOC, by means of carbon adsorption. (Facilities with inadequate space or steam capacity for adsorbers are excluded.) b. Reduction of VOC emissions from filter and distillation wastes. c. Eliminate liquid and vapor leaks.
VOC reduction per facility (pp. 2-5, 2-7)*	Carbon adsorption applied to commercial and industrial plants will reduce overall VOC emissions by 40-75 percent.
Costs (p. 4-5)*	Basis: Carbon adsorbers for a commercial plant cleaning 46,000 kg (100,000 lb) of clothes per year. Capital cost $4,500 Annualized cost $300 Cost effectiveness $90 credit/Mg $80 credit/ton

*The source of the summary information is the indicated page number in "Control of Volatile Organic Emissions from Perchloroethylene Dry Cleaning Systems," EPA-450/2-78-050.

SECTION 9

LEAKS FROM PETROLEUM REFINERY EQUIPMENT[8]

Petroleum refineries produce gasoline, aromatics, kerosene, distillate fuel oils, residual fuel oils, lubricants, asphalt and other products through distillation of petroleum or through redistillation, cracking, rearrangement or reforming of unfinished petroleum derivatives. The major sources of refinery VOC emissions, that have been addressed in previous CTG documents, are fixed roof storage tanks; vacuum producing systems, wastewater separators, and process unit turnarounds; and gasoline transfer operations.

Even though present estimates show that petroleum refinery leaks are a significant source of VOC emissions, the emission factors which yield these estimates are based on 20-year old data. Emission factors for petroleum refinery equipment leaks are being updated, and preliminary data indicate the total leak emission rate is greater than present estimates.

The CTG document recommends a two-phase program of monitoring and maintenance to control VOC emissions from petroleum refinery equipment leaks. A 10,000 ppm VOC concentration, when tested in the manner described in Appendix B of the document, constitutes a leak. The monitoring plan consists of annual inspection of pump seals, pipeline valves in liquid service, and process drains; quarterly inspection of compressor seals, pipeline valves in gas service, and pressure relief valves in gas service; and weekly visual inspection of pump seals. The maintenance portion of the program consists of repairing any detected leaks within 15 days. In some cases it will not be possible to complete the repair until the next scheduled unit turnaround. These leak sources need not be repaired until the necessary shutdown occurs. In certain instances more than unit shutdown repairs will be necessary to bring a leaking component into compliance. Temporary variances should be available where leaking components cannot be repaired by maintenance or equipment changeout.

The CTG also recommends recording and reporting requirements to facilitate the monitoring and maintenance program. A leaking components monitoring log should be kept which contains identifying information on leaks and their repair. Also quarterly reports should be submitted to the air pollution control agency certifying that the monitoring has been performed according to the company's control plan and identifying leaks that were not repaired within 15 days of their discovery.

The CTG docuemnt does not present calculations for recovered product credits or cost-effectiveness ratios because emission reduction factors were

not available. The necessary factors became available in January 1980 and have been used to calculate the emission reduction and cost-effectiveness figures presented in the following table.[13]

SUMMARY OF CTG DOCUMENT FOR LEAKS FROM PETROLEUM REFINERY EQUIPMENT

Affected facilities (p. 6-1)*	Petroleum refinery equipment including pump seals, compressor seals, seal oil degassing vents, pipeline valves, flanges and other connections, pressure relief devices, process drains, and open ended pipes.
Number of affected facilities	There were 311 petroleum refineries in the nation as of January 1, 1979.[12]
VOC emissions nationwide (p. 5-1)*	The estimated VOC emissions nationwide are 170,000 Mg/year, or about 1 percent of the total VOC emissions from stationary sources.
VOC emissions range per facility (p. 3-2)*	The potential VOC emissions per leaking source range from 1.0 to 10 kg/day.
100 ton/year source size (p. 1-3, 2-3)*	A single leaking source has the potential to emit 0.4 to 3.7 Mg VOC/year (0.5 to 4.1 ton/yr). A refinery with between 25 and 227 leaking components would emit 100 tons/year of VOC. A model medium size refinery may have 90,000 leaking components.
CTG emission limits (p. 1-3)*	If a leaking component has a VOC concentration of over 10,000 ppm at the potential leak source, it should be scheduled for maintenance and repaired within 15 days.
VOC reduction per facility (calculated)	Estimated to prevent the release of 1821.1 Mg/year (2007.4 ton/year) of VOC at a model medium size refinery (15,900 m^3/day) by reducing emissions from 2933.6 Mg (3233.5 ton) to 1112.5 Mg (1226.1 ton) per year.[13]
Costs (p. 4-8)*	Basis: A monitoring and maintenance program for a 15,900 m^3/day (100,000 bbl/day) refinery (Fourth quarter 1977 dollars). Instrumentation Capital Cost 8,800 Total Annualized Costs 115,000 Cost Effectiveness $/Mg (86.85)†[13] $/ton (78.81)†[13]

*The source of the summary information is the indicated page number(s) in "Control of Volatile Organic Compound Leaks from Petroleum Refinery Equipment," EPA-450/2-78-036.

†Numbers in parentheses are savings.

SECTION 10

PETROLEUM LIQUID STORAGE IN EXTERNAL FLOATING ROOF TANKS[9]

Petroleum liquid storage in external floating roof tanks occurs at petroleum refineries, terminals, tank farms and along pipelines. The recommended control technology is retrofitting certain affected tanks with rim-mounted secondary seals.

There are several exceptions to the general requirement that all external floating roof petroleum liquid storage tanks larger than 150,000 liters (40,000 gal) must have secondary seals. The exempt liquid storage tanks are those which:

1. are used to store waxy, heavy pour crude oil;

2. have capacities less than 1,600,000 liters (420,000 gal) and are used to store produced crude oil and condensate prior to lease custody transfer;

3. contain a petroleum liquid with a true vapor pressure of less than 10.5 kPa (1.5 psi);

4. contain a petroleum liquid with a true vapor pressure less than 27.6 kPa (4.0 psi); and

   (a) are of welded construction; and

   (b) presently possess a metallic-type shoe seal, a liquid-mounted liquid filled type seal, or other closure device of demonstrated equivalence;

5. are of welded construction, equipped with a metallic-type shoe primary seal and have a secondary seal from the top of the shoe seal to the tank wall (shoe-mounted secondary seal).

Tanks storing waxy, heavy pour crude oil are exempted because waxy deposits on the tank wall would damage the secondary seal. If the tank is of riveted construction and not used for lease custody transfer, the only exemption is when true vapor pressure is less than 10.5 kPa. If the vessel is welded construction (and also not used for lease custody transfer) the vapor pressure exemption becomes a function of the existing primary seal type. If the seal is a metallic-shoe type, liquid-mounted foam type, liquid-mounted liquid filled type, or equivalent, the minimum true vapor pressure for exemption rises to 27.6 kPa (4.0 psi). For other primary seals on welded tanks, the minimum vapor pressure for exemption remains at 10.5 kPa (1.5 psi).

Finally, if the tank is of welded construction, equipped with a metallic shoe seal and has a secondary seal from the top of the shoe seal to the tank wall (shoe mounted secondary seal) it is not an affected facility.

The affected tank size changes from 150,000 liters (40,000 gal) to 1,600,000 liters (420,000 gal) only for tanks storing produced crude oil and condensate prior to lease custody transfer (oil field production storage). This exception applies to tanks storing petroleum liquid from the time it is removed from the ground until custody is transferred from the production operation to the transportation operation.

A rim-mounted secondary seal is continuous and extends from the floating roof to the tank wall, above, and covering the entire primary seal. Installed over mechanical shoe seals, liquid mounted primary seals or vapor mounted primary seals, rim-mounted secondary seals effectively reduce VOC emissions. In order for the secondary seal to be effective, the accumulated area of gaps exceeding 0.32 cm (1/8 in.) in width between the secondary seal and the tank wall should not exceed 21.2 cm^2 per meter of tank diameter (1.0 $in.^2$ per foot of tank diameter).

Several ancillary control techniques are recommended in the CTG document. These include keeping covers, seals and lids closed except when in actual use and providing projections below the liquid surface on certain openings. Also automatic bleeder vents should be kept closed except when the roof is floated off or landed on the roof leg supports, and rim vents should be set to open only when the roof is being floated off the roof leg supports. Finally, roof drains should be provided with slotted membrane fabric covers or equivalent.

SUMMARY OF CTG DOCUMENT FOR EXTERNAL FLOATING ROOF TANKS

Affected facilities (p. 1-2)*	External floating roof tanks larger than 150,000 liters (40,000 gal) storing petroleum liquids. See exceptions noted in text.
Number of affected facilities (p. 2-1)*	There is an estimated 13,800 internal and external floating roof tanks that are larger than 150,000 liters (40,000 gal). The number of external floating roof tanks is not available.
VOC emissions nationwide (p. 1-2)*	An estimated 65,000 Mg (71,000 tons) of VOC was emitted in 1978 which represents about 4.0 percent of stationary source estimated emissions.
VOC emission range per facility (pp. 3-3, 3-9)*	The emission range for a 30.5 m (100 ft) diameter tank storing 41.4 kPa (6 psi) vapor pressure gasoline is 212 Mg/yr (233 tons/yr) for a slightly gapped primary seal to 2.2 Mg/yr (2.4 tons/yr) for a tight rim-mounted secondary seal over a tight primary seal.
100 tons/yr source size	No single floating roof tank is expected to emit more than 100 tons/yr.[15]
CTG emission limit (pp. 5-1, 5-4)*	A continuous secondary seal or equivalent closure on all affected storage tanks, plus certain inspection and recordkeeping requirements.
VOC reduction per facility (pp. 3-3, 3-9)*	Ranges from about 200 to 2 Mg/yr (220 to 2.2 tons/yr).
Costs (pp. 4-9, 4-12)*	Basis: External floating roof tank 30.5 m (100 ft) in diameter with a capacity of 8.91×10^6 liters (55,000 bbl) controlled by a rim mounted secondary seal. Capital cost ($1000): 16.9 Annualized cost ($1000): 3.3 Cost effectiveness ($/Mg): (66)†-3,655 Cost effectiveness ($/ton): (59)†-3,316

*The source of the summary information is the indicated page(s) in "Control of Volatile Organic Emissions from Petroleum Liquid Storage in External Floating Roof Tanks," EPA-450/2-78-047.

†Numbers in parenthesis indicate credits.

SECTION 11

LEAKS FROM GASOLINE TANK TRUCKS AND VAPOR COLLECTION SYSTEMS[10]

The intent of this guideline is to define leak tight conditions and related test procedures for vapor collection systems and tank trucks while loading and unloading at bulk plants, bulk terminals and service stations. The two separate affected facilities are gasoline tank trucks that are equipped for vapor collection and vapor collection systems at bulk terminals, bulk plants, and service stations that are equipped with vapor balance and/or vapor processing systems. The control approach is a combination of testing, monitoring, and equipment design requirements to ensure good operation and maintenance practices.

Annual testing of gasoline tank trucks is recommended. The test consists of pressurizing to 4,500 Pa (18 in. of water) and evacuating to 1,500 Pa (6 in. of water). The truck tank should not sustain a pressure change of more than 750 Pa (3 in. of water) in 5 minutes under either condition. Each truck tank should display a sticker indicating the date it last met this pressure and vacuum test criteria.

The vapor collection and vapor processing equipment should be designed and operated to prevent gauge pressure in the tank truck from exceeding 4,500 Pa (18 in. of water) and prevent vacuum from exceeding 1,500 Pa (6 in. of water). In addition, vapor concentration at 2.5 cm around the perimeter of a potential leak source should be below 100 percent of the lower explosive limit (LEL, measured as propane) at all times when measured by a combustible gas detector.

The CTG document provides detailed descriptions of the testing of tank trucks and vapor collection systems. In addition, calibration procedures for the combustible gas detectors which are recommended for use by regulatory agencies for compliance monitoring are provided. Recordkeeping and reporting requirements are also discussed in the CTG document.

Additional information on control techniques, costs, and monitoring procedures is presented in a report entitled "Evaluation of Vapor Leaks and Development of Monitoring Procedures for Gasoline Tank Trucks and Vapor Piping," EPA-450/3-79-018, April 1979.

SUMMARY OF CTG DOCUMENT FOR LEAKS FROM GASOLINE TANK TRUCKS AND VAPOR COLLECTION SYSTEM

Affected facilities (p. 2)*	a. Gasoline tank trucks that are equipped for vapor collection. b. Vapor collection systems at bulk terminals, bulk plants, and service stations that are equipped with vapor balance and/or vapor processing systems.
Number of affected facilities	Not available
VOC emissions nationwide	Not available
VOC emission range per facility	Not available
CTG emission limit (pp. 1 and 2)	The control approach is a combination of testing, monitoring, and equipment design to ensure that good maintenance practices are employed to prevent leaks from truck tanks or tank compartments and vapor collection systems during gasoline transfer at bulk plants, bulk terminals, and service stations. A leak is a reading greater than or equal to 100 percent of the LEL at 2.5 cm from a potential leak source as detected by a combustible gas detector.
VOC reduction per facility	Not available
Costs	Not available

*The source of the summary information is the indicated page number in "Control of Volatile Organic Compound Leaks from Gasoline Tank Trucks and Vapor Collection Systems," EPA-450/2-78-051.

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